### 8.7.1 Shading Devices

Solar heat gain through windows can be as much as three times more than heat loss because direct radiation is instantaneously transmitted to the building interior. The incident solar radiation received by a vertical surface often exceeds 200 Btu/hr/ft$^2$, and the annual operating cost of cooling equipment attributed to each square foot of ordinary glass is considerable.

The desirability of direct solar heat is evaluated quite differently depending on location, climate, orientation, and time of day. Hot, arid regions generally require exclusion of solar radiation to prevent overheating, excessive air-conditioning loads, glare, or deterioration of materials. In other circumstances, it may be more desirable to ensure adequate sunlight, either for heat or purely for its psychological effect.

If sun control is necessary, the most efficient means is through the use of external shading devices. ASHRAE data indicates that exterior shading devices can reduce the instantaneous rate of heat gain by as much as 85%. Different orientations require different types of shading devices. Horizontal projections or overhangs work best on southerly orientations. Vertical fins are of little value on southern exposures, where the sun is high at midday. For easterly and westerly orientations, however, vertical fins work well. Horizontal elements are of little value here because low morning and afternoon sun altitudes negate their effect. Combination horizontal/vertical egg-crate devices work well on walls facing southeast, and are particularly effective for southwest orientations. Considered by some to give the best "all-around" shading, the egg-crate patterns are most advantageous in hot climates. Their high shading ratio and low winter heat admission, however, can be undesirable in colder regions.

Clay or concrete masonry screens can be assembled in many patterns, with either standard or custom units. Their shading characteristics are all of the egg-crate type (*see Fig. 8-39*). Masonry screens can be constructed in stack bond, running bond, or split bond (where the individual units are separated horizontally and the wall contains no vertical mortar joints). Standard concrete block or clay tile can be laid with cores perpendicular to the wall surface to create screen effects, or decorative units made expressly for this purpose can be used. Solid brick can be laid in split bond to give open screen patterns of various designs. The overall texture and appearance of the wall is affected by the size and shape of the units as well as the pattern in which they are assembled. Both glazed and unglazed units are available in a variety of colors. Lighter colors provide brighter interior spaces because of greater reflectance. Darker colors reflect less light (*see Fig. 8-40*). Depending on orientation and latitude, small screen patterns can exclude much or all of the direct sun load.

Glass block has passive solar applications too. In the winter, when the sun is low on the horizon, south-facing glass block panels transmit large amounts of solar energy to the interior. In the summer, when the sun is high overhead, the horizontal and vertical mortar joints form an egg-crate shading device to limit heat gain.

The degree of shading provided by a masonry solar screen is a function of the shape, dimensions, and orientation of the openings. Standard sun path diagrams and shading masks can be used to compute time–shade cycles for openings of any shape, or to custom design a screen for a specific latitude and orientation. Masonry screens can be used to reduce heat gain economically when building orientation cannot be easily adjusted. They can also be retrofitted to existing buildings to substantially reduce air-conditioning loads and lower overall energy consumption.

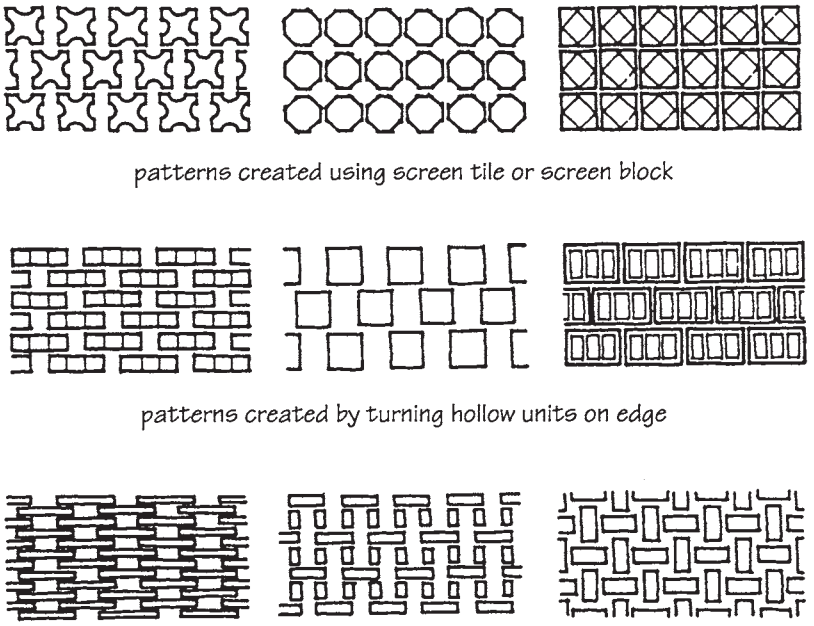


**Figure 8-39** Masonry screen wall patterns. (*From Brick Industry Association,* Technical Notes, Vol. 11, No. 11*, BIA, Reston, VA.*)

### 8.7.2 Direct-Gain Solar Heating

The simplest method of solar heating is *direct gain.* If a building is constructed of lightweight materials, solar radiation will heat its low thermal mass quickly and raise inside air temperatures above comfortable levels. At night, these buildings lose their heat just as rapidly, causing temperatures to drop again. Better designs allow sunlight to strike materials of high thermal mass which can store the heat and reradiate it at a later time (*see Fig. 8-41*). Contemporary materials include poured and precast concrete as well as masonry. When these materials with high heat storage capacity are used for